

II. REMARKS

A. Introductory Remarks

Reconsideration and allowance of this application is earnestly requested. Claims 8-19 are pending in this application. Claims 1-7 were previously canceled. Applicants, however, reserve the right to file a continuation or divisional application on the subject matter of any of the canceled claims.

B. Rejection of Claims 8-19 Under §103(a) Should Be Withdrawn

The Office Action dated October 11, 2006 rejected claims 8-19 under 35 U.S.C. §103(a) as allegedly obvious over U.S. Patent 5,858,813 (“Scherber”) in view of U.S. Patent 6,569,349 (“Wang”) for the reasons cited on the following pages. Applicants respectfully traverse these rejections.

As stated by the Federal Circuit, “a proper analysis under 35 U.S.C. §103 requires, *inter alia*, consideration of two factors: (1) whether the prior art would have suggested to those of ordinary skill in the art that they should make the claimed composition or device, or carry out the claimed process; and (2) whether the prior art would also have revealed that in so making or carrying out, those of ordinary skill would have a reasonable expectation of success.” *In re Vaeck*, 947 F. 2d 488, 493 (Fed. Cir. 1991). In addition, the prior art references must teach or suggest all the claim limitations. The teaching or suggestion to combine and the reasonable expectation of success must be found in the prior art, and not in the applicants’ disclosure. *Id.* at 493. See, also MPEP §2142. Further, the Federal Circuit recently held “[t]he best defense against the subtle but powerful attraction of hindsight-based obviousness is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references.” (*In re Lee*, 61 U.S.P.Q.2d 1430, 1433 (Fed. Cir. 2002), quoting from *In re Dembiczak*, 50 U.S.P.Q. 2d 1614, 1617 (Fed Cir. 1999)). Applicants respectfully submit that the references of Scherber and Wang cited in the Office Action fail to meet the tests prescribed by the Federal Circuit as discussed below.

1. Scherber

Scherber teaches a polishing slurry for chemically mechanically polishing (CMP) metal layers and films during the various stages of multilevel interconnect fabrication. See abstract. Scherber's slurry includes an aqueous medium, an abrasive, an oxidizing agent, and an organic acid. See abstract and col. 2, lines 33-36. As cited in the Office Action, Scherber discloses that the suitable oxidizing agents include periodic acids (0.5 to 15% by weight). See col. 5 lines 7-13. Further, as cited in the Office Action, Scherber discloses that chemical mechanical polishing involves 'concurrent' chemical and mechanical polishing of an overlying first layer to expose the surface of a non-planar second layer on which the first layer is formed. See col. 1, lines 34-38. Additionally, Scherber teaches his polishing slurry may be used to provide controlled polishing selectivities to thin-film materials such as titanium, titanium nitride, titanium tungsten and similar alloys. See col. 10 lines 14-20. Thus, from the foregoing disclosure in Scherber, it is quite clear to one skilled in the art that Scherber is concerned with and directed to improved method of using chemical mechanical polishing slurries for polishing metal layers and thin-films used in semiconductor integrated circuit manufacturing. See col. 1, lines 8-11. [emphasis added].

2. Wang

Similarly, Wang is directed to a slurry composition for chemical mechanical polishing and planarization (CMP). See abstract. Wang teaches a polishing slurry composition that comprises oxidizers, chelating agents, surfactants, polar solvent, corrosion inhibitors, and may include an abrasive. See col. 2 lines 15-21. As cited in the Office Action Wang teaches polishing and planarizing TiW substrate. See col. 6 lines 42-49. Further, as cited in the office action, Wang teaches using a first polishing composition in the CMP process to remove at least a portion of the copper layer **313** with high selectivity to TaN barrier layer **312** to stop thereon. A second CMP composition and CMP process is used for planarizing TaN and the underlying barrier layer to remove the TaN barrier layer and to reduce scratching defects formed on the dielectric layer on the substrate surface thereby completing planarization. See col. 8, lines 9- 25. Thus, from the foregoing discussion it is clear to one skilled in the art that Wang is concerned

and directed to a chemical mechanical planarization (CMP) composition and a method to planarize a substrate comprising a metal layer and a barrier layer over a dielectric layer.

3. Invention of Claims 8 and 14

In contrast to Scherber and Wang, Applicants respectfully submit that claims 8 and 14 define a method of etching and cleaning a substrate comprising TiW alloy layer that does not involve chemical mechanical planarization (CMP) or polishing step. As discussed previously in the response filed on July 11, 2006, claim 8 defines an alternate embodiment that is directed to a process of etching and cleaning the etching residue from a substrate comprising an exposed TiW alloy layer, which further comprises at least one of Al, Cu, or an AlCu alloy and removing the residues of etching TiW alloy wherein the removal rate of TiW alloy and residue thereof is greater than a removal rate of Al, Cu, or an AlCu alloy. Claim 14 defines a method of etching and cleaning TiW layer comprising providing a substrate comprising a TiW alloy layer and etching residues from prior etching of the TiW layer and contacting the substrate with a solution containing hydrogen peroxide to remove the exposed TiW alloy.

It should be noted that this application is a CIP of application No. 09/226,996, filed on January 7, 1999, now U.S. Patent No. 6,635,186. Whereas the parent U.S. Patent 6,635,186 discloses and claims a method of CMP, this application additionally discloses and claims a method of etching and cleaning TiW alloy layer using periodic acid or hydrogen peroxide as an oxidant. See paragraphs [0045] through [0055] including examples 1, 2, and 3 in the specification.

As one of skill in the art fully knows and appreciates, a CMP process is significantly different from etching both in theory and practice. For example, Scherber, discloses and utilizes a CMP (chemical mechanical polishing) to planarize the surface of metal layers or thin-films during the various stages of device fabrication.” See col. 1, lines 30-34. Scherber discloses that the CMP involves concurrent chemical and mechanical polishing of an overlying first layer to expose the surface of a non-planar second layer on which the first layer is formed. See col. 1, lines 35-38. Cleaning, as in the present application, may occur after the CMP process but not during. The instant specification also discloses that “The CMP process removes the excess material through a wet chemical etch of the surface material followed by a mechanical abrasion

of the etched surface.” See paragraph [0044] in the instant specification. Thus, CMP involves a chemical and mechanical aspect to remove substrate and planarize the surface.

In contrast to CMP method, the method of “etching” as described in the specification is another embodiment of the invention where an oxidizer such as periodic acid and hydrogen peroxide is used to “dissolve” the exposed TiW alloy substrate surface. See paragraphs [0060] - [0067]. Further, paragraph [0041] defines the meaning and phenomenon of “*Etching the surface*” as “*The impurity and a certain thickness of the substrate surface is dissolved.*” Similarly, Scherber discloses etching as “*The dissolution of aluminum after the abrasion (which is equivalent to wet etching) is low...*” See col. 9 lines 66-67. Thus, etching as defined in both Scherber and in the instant specification is the chemical oxidation and dissolution of the substrate surface, *without* the additional or concurrent step of mechanical polishing or planarization using an abrasive slurry and polishing pad.

In view of the distinction between etching and CMP methods, Applicants respectfully submit that claims 8 and 14 define an alternate embodiment that does not involve CMP. In other words, claims 8 and 14 do not recite the use of abrasive particles, chelating agents, surfactants and importantly a polishing step (mechanical planarization) of the substrate even though such CMP process is disclosed in the instant specification, which however, the pending claims do not encompass. Instead, claims 8 and 14 define and are directed to a method of etching, i.e., removing, cleaning and rinsing the etched residue by using an oxidant such as periodic acid or hydrogen peroxide. Furthermore, Scherber and Wang teach away from the present invention by requiring both a chemical *and* mechanical aspect to the process. Unlike Scherber and Wang, the claimed invention does not include a mechanical aspect. There is no teaching in Scherber or Wang that suggests in any way that the Scherber or Wang process could be practiced without a mechanical aspect. Thus, claims 8 and 14 are unobvious over Scherber and Wang.

4. No Motivation or Suggestion to Combine Scherber and Wang

Applicants respectfully submit that there is no suggestion in either Scherber or Wang to modify the references or to combine their teachings to arrive at the invention of claims 8 and 14. As discussed above both Scherber and Wang are directed to a polishing slurry composition and method for CMP (chemical mechanical planarization) of substrates. However, both Scherber

and Wang fail to teach or suggest a method of etching TiW and cleaning the TiW residue layer as defined in independent claims 8 and 14.

Contrary to the assertion in the Office Action that Scherber suggests polishing step in combination with etching to form residue and cleaning afterwards, Applicants respectfully submit that claims 8 and 14 do not define a polishing step, which is a necessary step of CMP method. Further, regarding the assertion that it would have been obvious to provide a substrate comprising an exposed TiW alloy layer and etching the TiW alloy by a method which results in formation of etching residue in the method of Scherber because Wang teaches that this is a useful technique for planarization substrates to enable USLI, Applicants respectfully point out that there is no motivation in Wang to provide a method of etching the TiW alloy as defined in claims 8 and 14 because Wang is not directed to etching but to CMP i.e, planarization. Etching does not constitute polishing or planarization of the exposed TiW substrate and therefore there is no motivation to planarize the TiW substrate by etching. Rather, claims 8 and 14 define etching or dissolution of the TiW alloy layer and cleaning of the dissolved residue using an oxidant without the CMP (planarization).

As discussed before in the previous response, etching involves removing the metal substrate and forming grooves in the substrate. Such grooves are in the substrate are cleaned by, for example, a method as defined in claim 8, and a barrier layer may be deposited and the grooves subsequently filled up by adding excess conductive material (first layer). The CMP process typically as disclosed in Scherber and Wang removes the excess of overlying first layer, exposing the material disposed on the grooves or even removing the second barrier layer as in the case of Wang. Thus, etching and cleaning are conducted before the first layer is added to the substrate.

Accordingly, one skilled in the art of CMP of semiconductor surfaces, who is familiar with Scherber, would not look to Wang to solve problems relating to method of etching, in part because neither Wang nor Scherber teach or suggest wet etching of the TiW substrate and cleaning of the residue. Thus, for at least this reason, the combination of Scherber and Wang does not render obvious independent method claims 8 and 14.

5. Combination of Scherber and Wang Fails to Teach All Elements of Claims 8 and 14

Applicant submits that even if there was suggestion or motivation to combine Scherber and Wang — which as discussed there is not— the combination does not teach all the limitations of the invention of claims 8 and 14. Scherber does not teach or suggest the limitations of etching the exposed TiW alloy and removing the TiW etch residue using periodic acid or hydrogen peroxide. As discussed above, Scherber discloses a CMP process and does not solve the problem of etching of exposed TiW alloy. Similarly, Wang teaches a two-step CMP process involving exposing the substrate in the first step by polishing method and removing the exposed substrate in the second step also by polishing method. Further, Wang does not teach periodic acid as an oxidizer. Clearly the combination of Scherber and Wang fail to teach the steps of etching of exposed TiW alloy using an oxidant and cleaning the dissolved etched substrate residue. Thus, there is no valid basis to combine these references but, even if the references are combined, the applicants' invention does not result. For this additional reason, the combination of Scherber and Wang fails to render obvious the subject matter of claims 55 and 56.

6. Conclusion

Since claims 8 and 14 define subject matter that are non-obvious over Scherber alone or in combination with Wang and there is no motivation or suggestion to combine Scherber with Wang in either of the references, the obviousness rejections are overcome. Accordingly, Applicants request reconsideration of the claims and allowance of claims 8 and 14. Additionally, Applicants submit that because independent claims 8 and 14 are allowable over Scherber and Wang, dependent claims 9-13 and 15-18 that depend from claims 8 and 14 respectively are also allowable.

III. Request for Allowance

In view of the amendments and arguments presented above, all claims are now thought to be in condition for allowance, an indication of which is solicited. In the event that any issues remain outstanding, Applicants would appreciate the courtesy of a telephone call to the undersigned counsel to resolve such issues in an expeditious manner so as to place this application in condition for allowance.

No fees are believed to be due. However, if any additional fees are determined to be due, the Commissioner is hereby authorized to charge these fees to the Morgan, Lewis & Bockius Deposit Account no. 50-0310.

Respectfully submitted,

MORGAN LEWIS & BOCKIUS LLP



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